

# WHAT REMOTE SUPPORT FROM INFRASTRUCTURE IS USEFUL TO CAV'S AND THE TRAFFIC NETWORK?

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*MAP traffic management, The Netherlands*

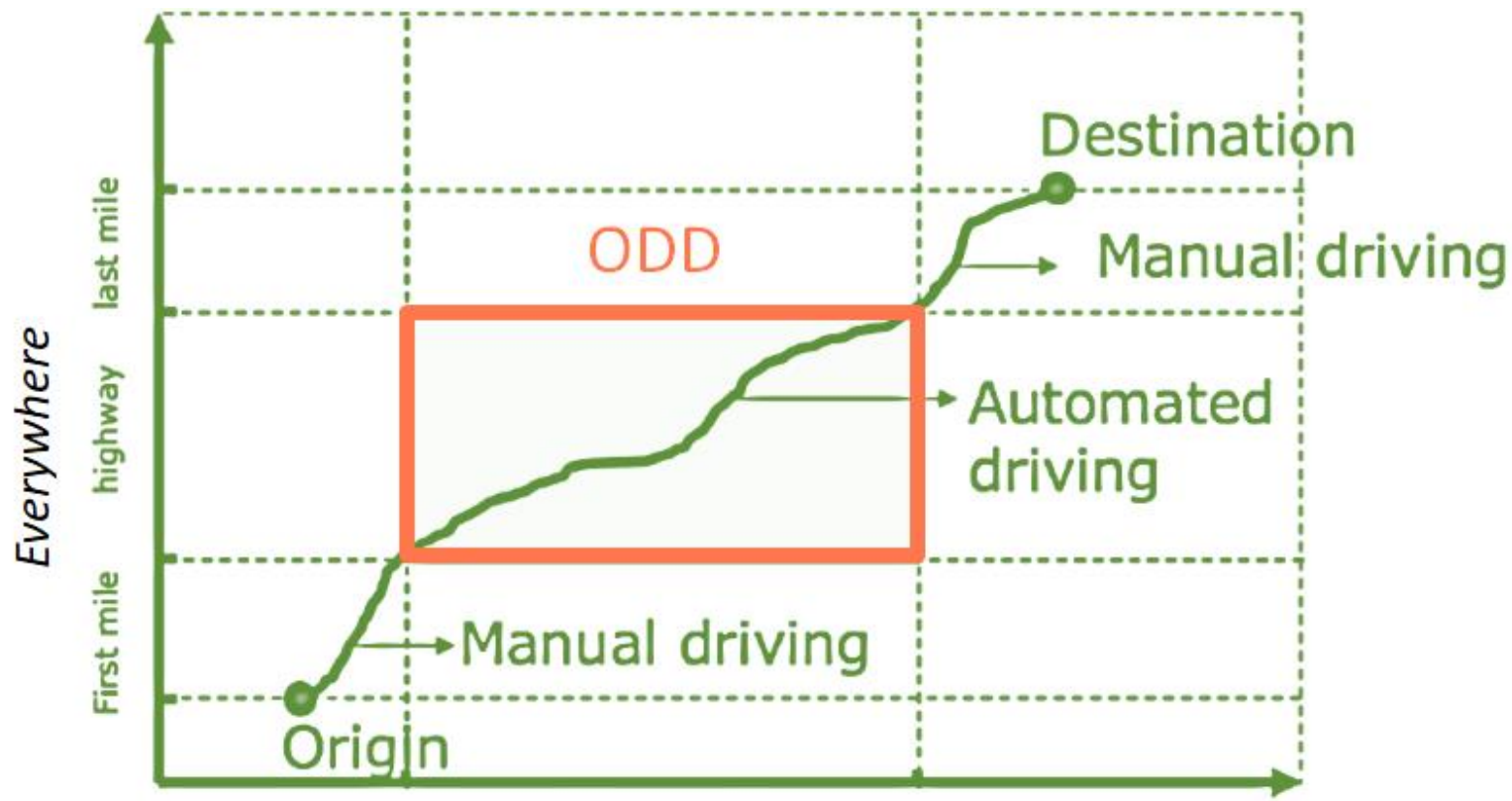
*SIS 53 Impact Assessment of Automated Vehicles on Traffic  
Flow and Environment, ITS World Congress 2018, Copenhagen*

# INFRASTRUCTURE

*... AV actively interact with their intelligent environment ...  
highly automated vehicles will have to be managed ... road  
infrastructure will play a major role ... real-time information  
and warnings ... traffic management plans, etc.*

- ✓ Safeguard societal 'system' interests
  - ✓ Provide support, rules, possibly
- ✓ Intervene in case of oversaturated conditions

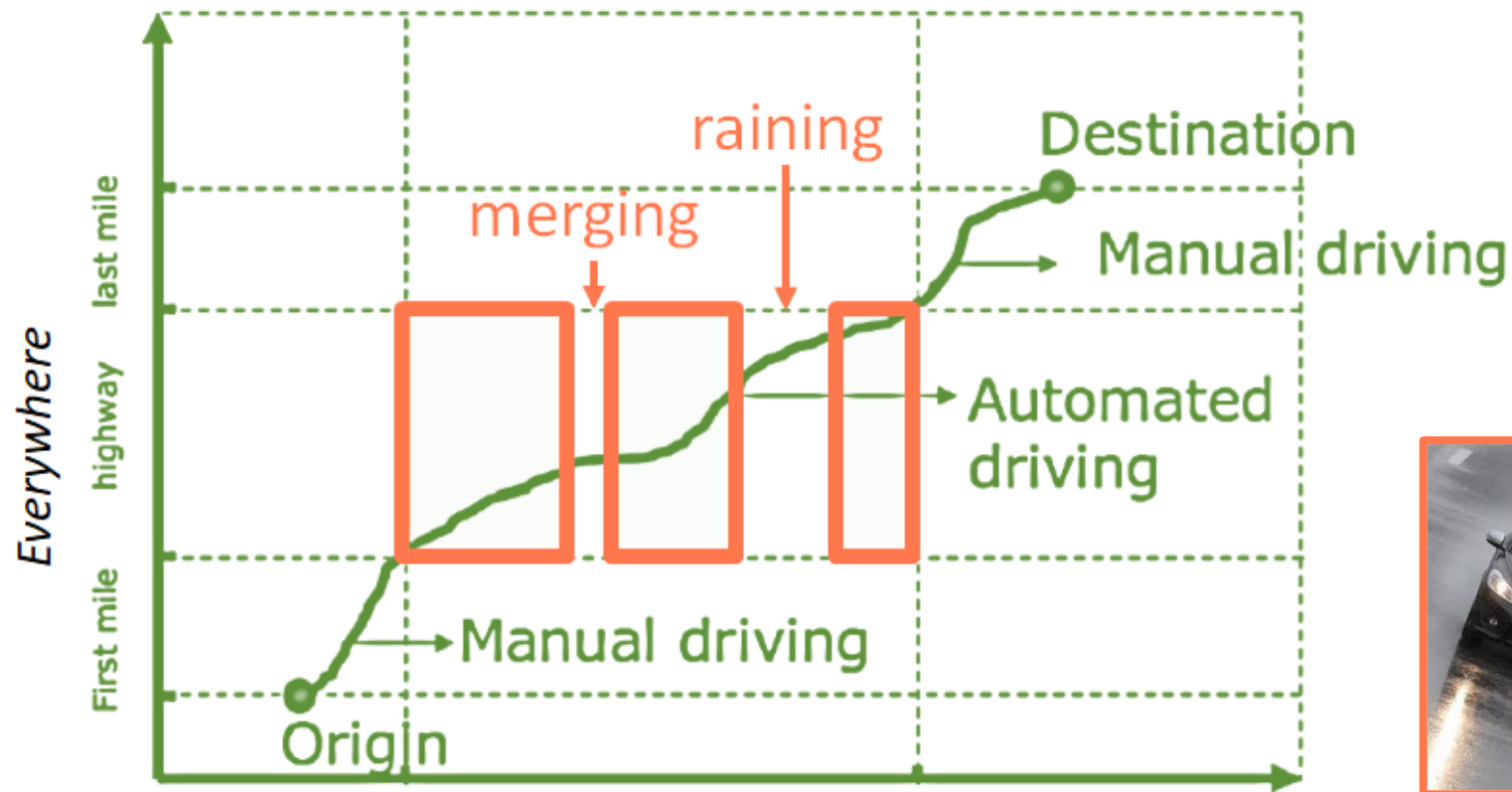
# OPERATIONAL DESIGN DOMAIN



*Always & All conditions*

*Tom Alkim, Rijkswaterstaat, 2017*

# INTERRUPTIONS = TRANSITIONS

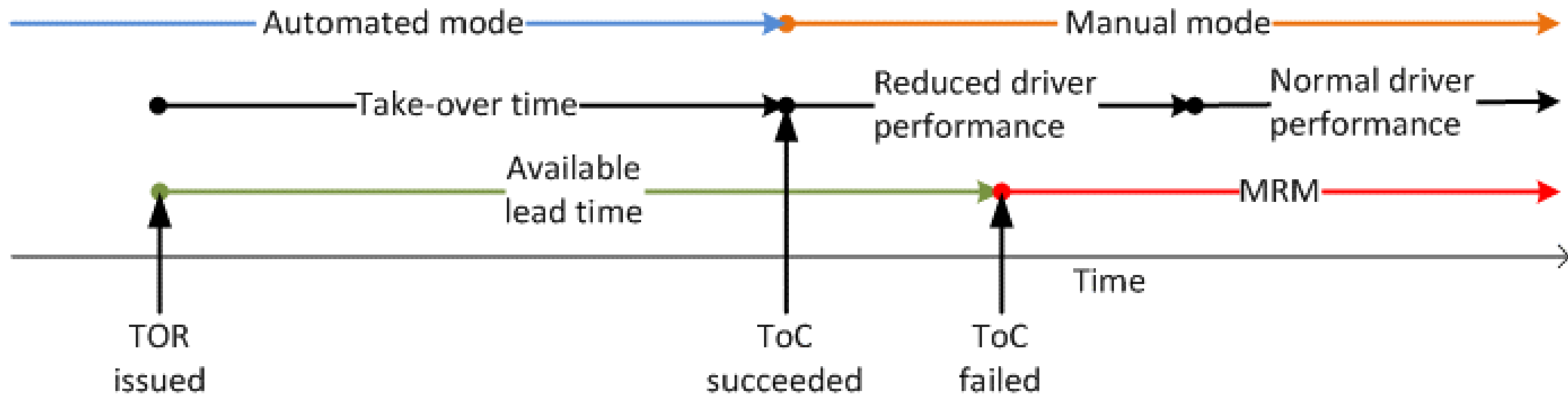


Always & All conditions



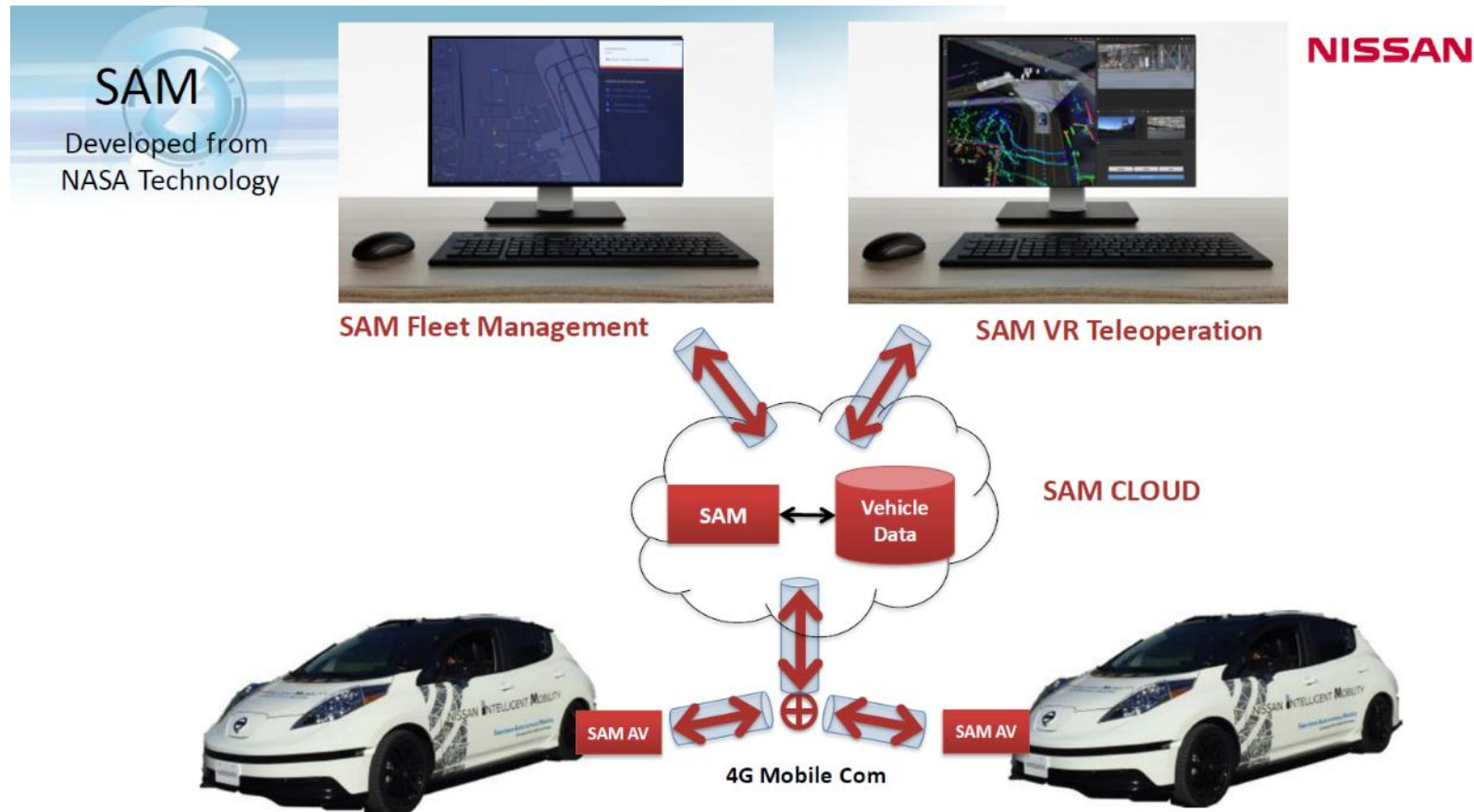
Tom Alkim, Rijkswaterstaat, 2017

# ODD ENDS: TOC OR MRM



- > Remote support from infrastructure, through a human operator, cloud service, I2V application or other, to extend the ODD.

# REMOTE SUPPORT BY OEM'S



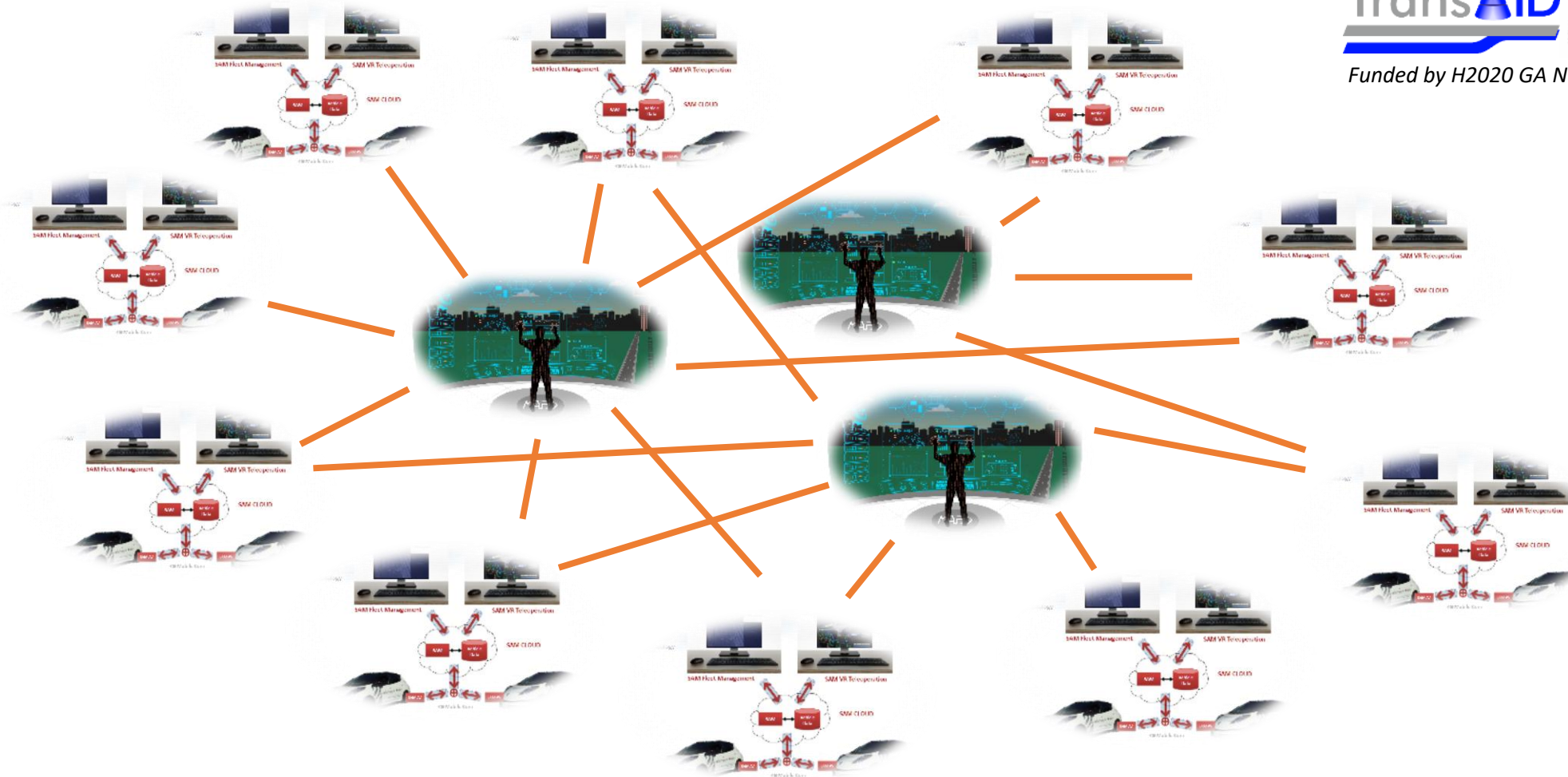
*Dr. Maarten Sierhuis,  
 Director, Nissan Research  
 Center, Silicon Valley,  
 Integrating Autonomous  
 Drive into the New  
 Automotive Reality  
 Automated Vehicle  
 Symposium 2017*

*<http://www.automatedvehiclessymposium.org/avs2018/2017-highlights/2017proceedings>*





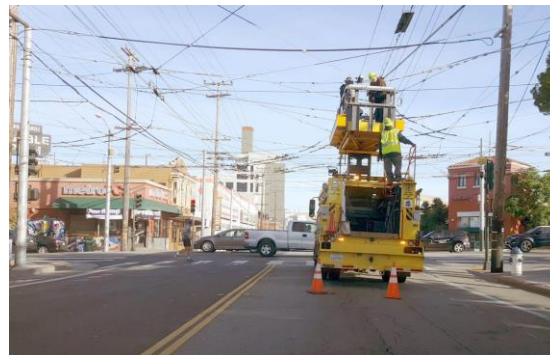
# UPSCALING AND REPLICABILITY



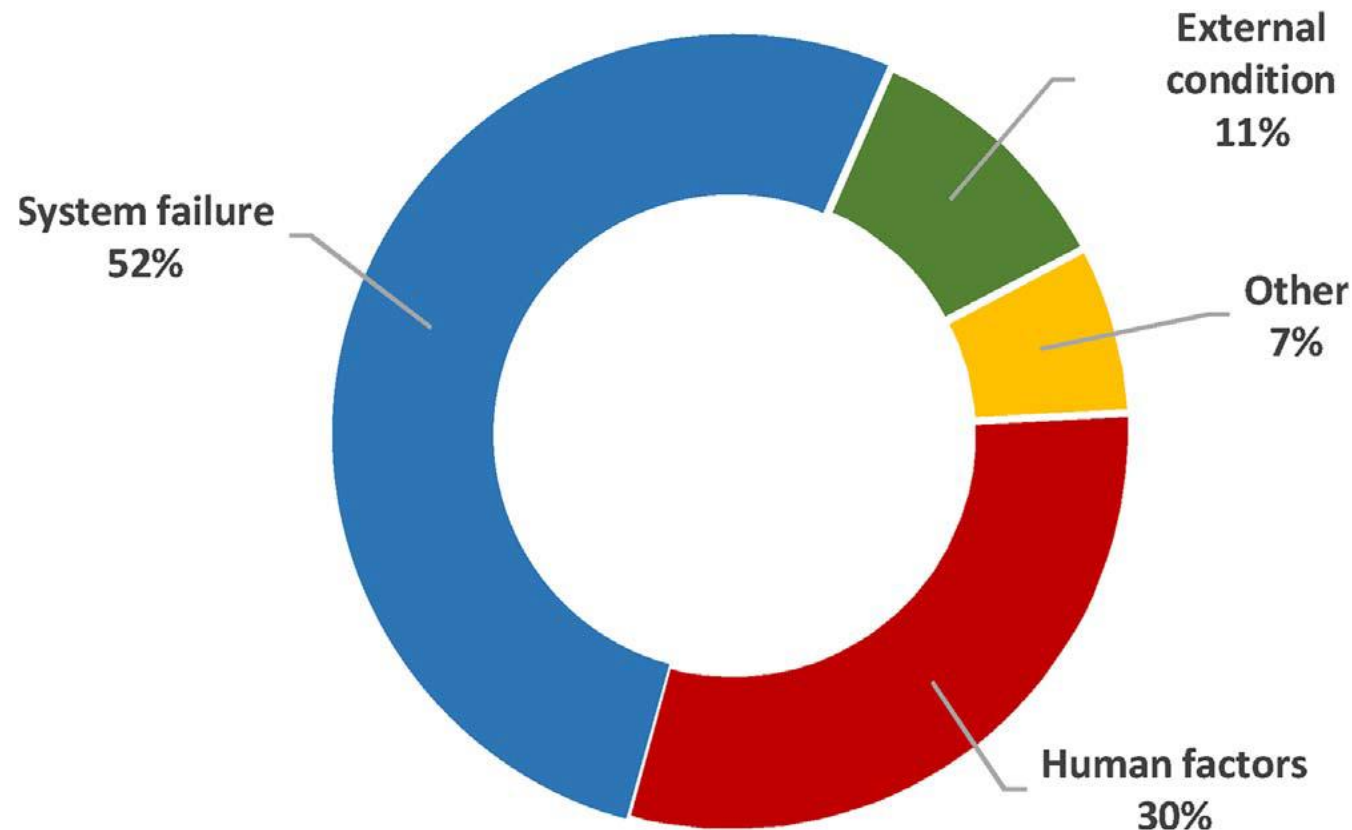


# WHEN, WHERE, WHY?

PERMANENT/TRANSIENT STATIC, TRANSIENT/HIGHLY DYNAMIC



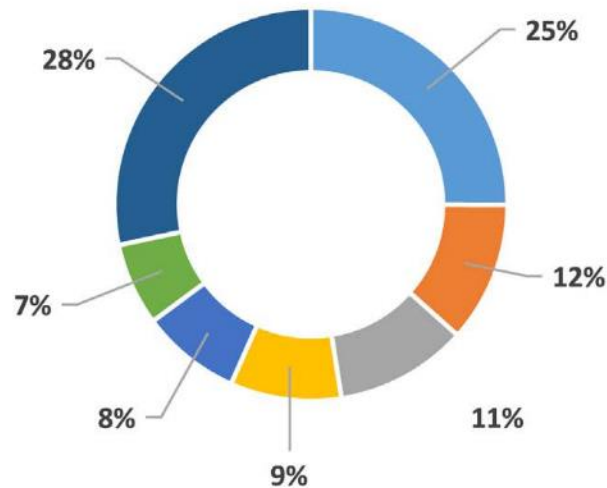
# Disengagement Reports



*Favaro et al. (2017), Autonomous vehicles' disengagements: Trends, triggers, and regulatory limitations, Accident Analysis & Prevention, Vol. 110, pp. 136-148*

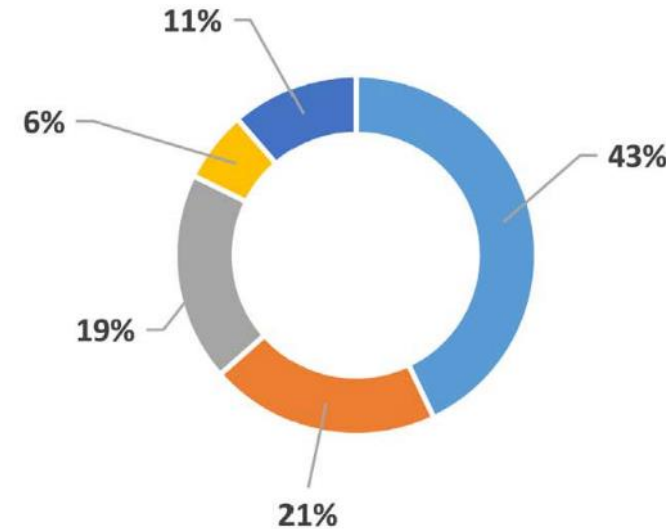
# DISENGAGEMENT REPORTS

## System failure



- software discrepancy
- perception discrepancy
- planner not ready
- traffic light detection
- lane change
- unwanted maneuver of vehicle
- Other System Failure factors\*

## External conditions

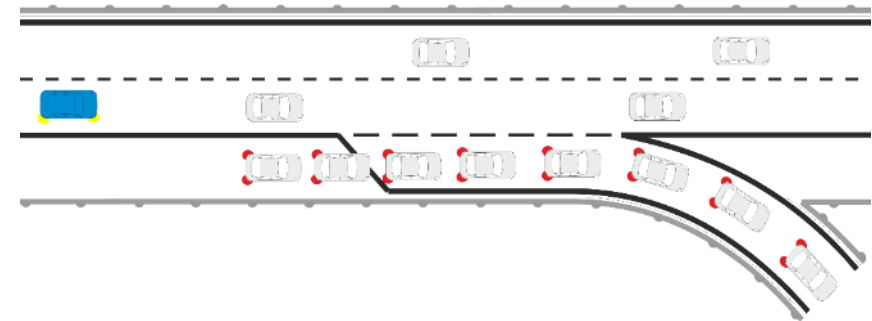
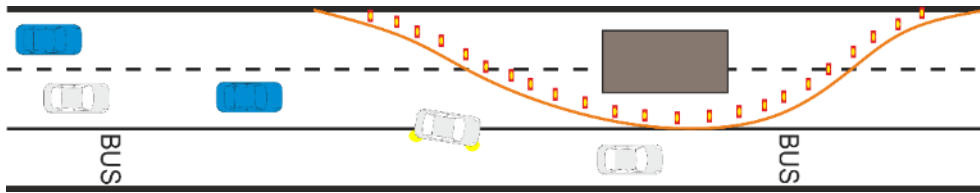


- poorly marked lanes
- construction zone
- heavy pedestrian traffic
- weather condition
- other external condition factors\*\*

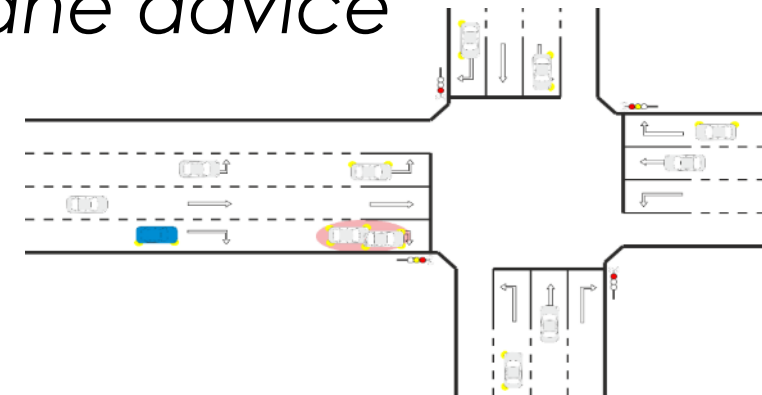
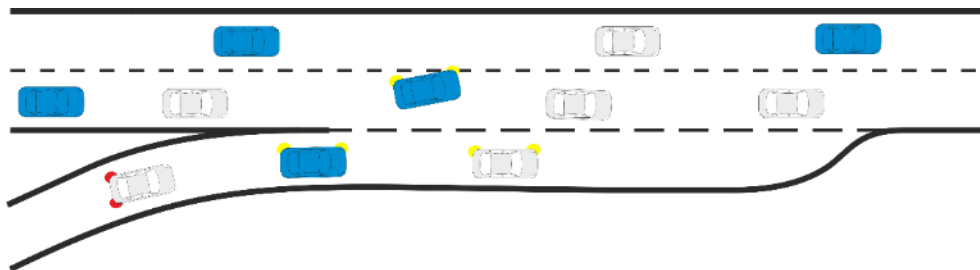
*Favaro et al. (2017), Autonomous vehicles' disengagements: Trends, triggers, and regulatory limitations, Accident Analysis & Prevention, Vol. 110, pp. 136-148*

# REMOTE SUPPORT FOR CAV'S

> *Provide vehicle path information*



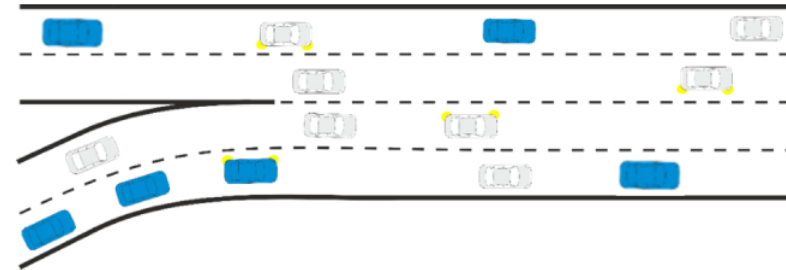
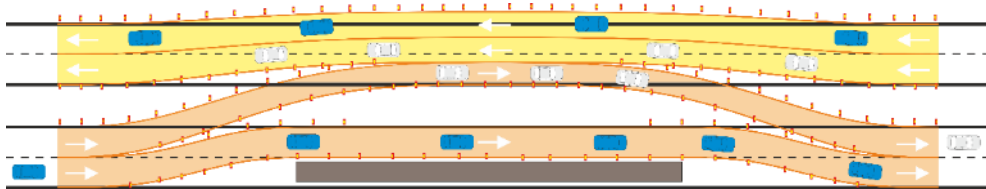
> *Provide speed headway and/or lane advice*



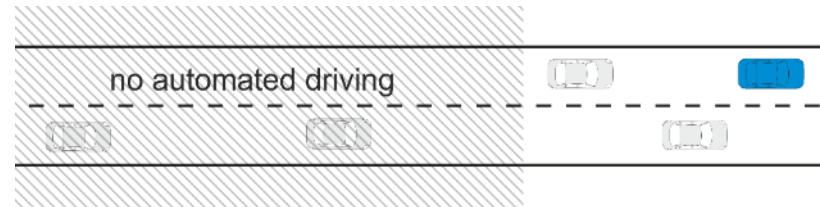
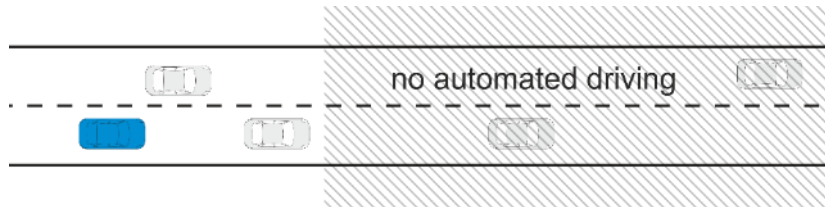


# REMOTE SUPPORT FOR CAV'S

## > Routing and traffic separation



## > Orchestration, distribution and scheduling

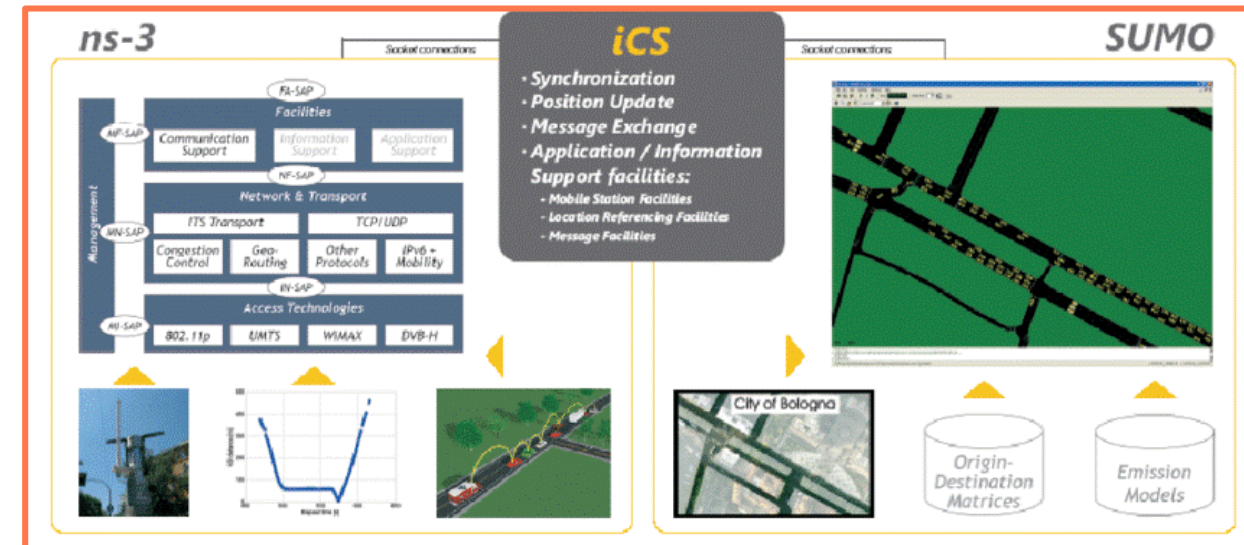


# CAUSALITY OF SITUATIONS AND SCENARIOS AS MOTIVATION OF THE DESIGN PROCESS

- > Boundaries / thresholds of the ODD (*critical values*).
- > Relevant performance indicators (*which can be monitored*).
- > Situation types e.g. discrete, incremental (*for predictability*).
- > AV deficiency that was triggered (*for providing right support*).
- > Extra step beyond typical monitoring & impact assessment

# RECENT AND ONGOING ACTIVITIES

- > Safety & efficiency metrics.  
→ published
- > Scenario timelines.  
→ 1st version published
- > ToC/MRM parameterisation.  
→ baseline → challenging
- > Modelling and simulation.
- > Field validation of ConOps.



# THANK YOU FOR LISTENING

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